

Coca-Cola Freestyle Engineering

TECHNICAL DOCUMENT



**KO310 Users Manual
Part Number: 0024566**

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Classified - Confidential

Revision History

Version	Date	Author	Changes
0.00	01-OCT-2024	K.Gibson	Initial draft for review
0.01	17-OCT-2024	K.Gibson	Set MPE value to 20cm, changed IC code to 8593A-KO310, removed KO310 block diagram

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KO310 Hardware User's Manual

KO310 Overview

Tx Output Power	10 to 27 dBm
Operating Frequencies	902 – 928 MHz 865 – 868 MHz
Package Size	39mm x 39mm
Package Type	52-pin surface mount module (castellated pads)
DC Supply	4.75 – 5.25 VDC
Current draw	< 700mA @ 5V

Regulatory Guidelines

The KO310 is approved for modular certification by FCC under the following ID numbers:

FCC ID: 2ADIR-KO310

IC: 8593A-KO310

Modular approval allows installation in different Coca-Cola Freestyle end-use products with limited or no additional testing or equipment authorization for the transmitter function provided by the KO310. Specifically:

- No additional transmitter compliance testing is required if the module is operated with one of the antennas listed in the document below.
- No additional transmitter-compliance testing is required if the module is operated with the same general type of antenna as those listed in this User's Guide and in the FCC filing for the KO310. Acceptable antennas must be of equal or less far field gain than the antennas previously authorized under the same FCC ID and must have similar in band and out of band characteristics.

In addition, the end-product must comply with all applicable FCC equipment authorizations, regulations, requirements and equipment functions not associated with the KO310. For example, compliance must be demonstrated to regulations for other transmitter components within the host product, to requirements for unintentional radiators (Part 15B), and to additional authorization requirements for the non-transmitter functions.

The Coca-Cola Freestyle product applying the KO310 is required to include all FCC and/or IC statements and warnings detailed in the following sections to the end-product labelling (where specified) and in the finished product manual. The Coca-Cola Freestyle product must also strictly adhere to antenna and installation guidelines and Maximum Power Exposure (MPE) as stated in this document.

Product Labelling

A statement must be included on the exterior of the final Coca-Cola Freestyle product which communicates that the device identified by the FCC and Industry Canada ID numbers are contained within the product. For example:

This product contains a radio module certified as FCC ID: 2ADIR-KO310 and IC: 8593A-KO310

OR

Contains FCC ID: 2ADIR-KO310

Contains IC: 8593A-KO310

The Coca-Cola Freestyle product must include the following statements on the exterior of the finished product unless the product is too small:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including any interference that may cause undesired operation.

Product Manuals

The user manual for the end-product must include the following information in a prominent location:

To comply with FCC's RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) & user's/nearby people's body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter

US Requirements

The finished product manual must contain the following statement:

WARNING: *The Federal Communications Commission warns that changes or modifications of the radio module within this device not expressly approved by The Coca-Cola Company could void the user's authority to operate the equipment.*

In the case where a Coca-Cola Freestyle product seeks class B (residential) limits for the host product, the finished product manual must contain the following statement:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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- *Reorient or relocate the receiving antenna.*
 - *Increase the separation between the equipment and receiver.*
 - *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
 - *Consult the dealer or an experienced radio/TV technician for help.*

In the case where a Coca-Cola Freestyle product seeks the lesser category of a Class A digital device for their finished product, the following statement must be included in the manual of the finished product:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his expense.

Canadian Requirements

The Coca-Cola Freestyle product must include the following regulatory statements (shown in italics) in both English and French on the exterior of the finished product and/or in the product manual:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The Coca-Cola Freestyle product must include the following regulatory statements (shown in italics) in both English and French in the finished product manual:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter IC: 8593A-KO310 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio IC: 8593A-KO310 a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- *Coca-Cola Freestyle Part 0017327, 8-position, trace antenna, -33.02 dBi*
- *Coca-Cola Freestyle Part 0015251, 12-position, trace antenna, -31.16 dBi*
- *Coca-Cola Freestyle Part 0014571, 1-position, trace antenna, 0.41dBi*
- *Coca-Cola Freestyle Part 0025329, 8-position, edge trace antenna, -36.98 dBi*
- *Coca-Cola Freestyle Part 0024586, 4-position, trace antenna, -36.53 dBi*

Antenna Requirements

When operating the KO310 under either FCC ID: 2ADIR-KO310 or IC: 8593A-KO310, the Coca-Cola Freestyle product must strictly follow these antenna guidelines:

- The Coca-Cola Freestyle product may operate only with the following antennas or antenna types with maximum gain as shown:
 - Coca-Cola Freestyle Part 0017327, 8-position, trace antenna, -33.02 dBi
 - Coca-Cola Freestyle Part 0015251, 12-position, trace antenna, -31.16 dBi
 - Coca-Cola Freestyle Part 0014571, 1-position, trace antenna, 0.41dBi
 - Coca-Cola Freestyle Part 0025329, 8-position, trace antenna, -36.98 dBi
 - Coca-Cola Freestyle Part 0024586, 4-position, trace antenna, -36.53 dBi

Refer to the “AT721003391 - FCC Antenna DataSheet” and “AT721003391 - EU Antenna DataSheet” for more information relating to the antennas approved for use with the KO310 module.

- RF I/O interface to the antenna connector(s) on the PCB shall be accomplished via a microstrip or stripline transmission lines with characteristic impedance of 50 ohms +/- 10%.
- The connector on the Coca-Cola Freestyle PCB which interfaces to the antenna must be of a unique type to disable connection to a non-permissible antenna in compliance with FCC section 15.203. The following connectors are allowed:
 - Right angle Reverse-Polarity SMA (RP-SMA) Jack : Amphenol part number 132136RP or equivalent
 - Ultra Miniature Coaxial Connector (UMCC) Jack: Molex part number 0734120110 or equivalent
 - Custom 50 ohm coaxial pigtail from PCB to antenna

- The Coca-Cola Freestyle product must professionally install the KO310 into its final environment to ensure that the conditions are met.

Maximum Power Exposure (MPE) and Usage Limitations

The minimum safe distance for people from the KO310 has been determined by conservative calculation to be less than 20 cm for the allowable antenna types. The end-product User's Guide must include the following statement in a prominent location:

To comply with FCC's RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) & user's/nearby people's body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.

KO310 Module Pin Descriptions

The following section describes each of the IO signals used by the KO310 module.

Pin Descriptions

Pin #	Pin Name	Pin Type	Description
1	RF0	Digital IO	GPIO used to control RF swi
2	RF1	Digital IO	GPIO that can be used to select antenna positions
3	GND	Power	Signal ground
4	PWR_EN	Digital IO	Enables power to KO310
5	RF_OUT	RF In/Out	RF Transmit/Receive pin
6	VDD	Power	DC supply voltage. 4.75 to 5.25V
7	GND	Power	Signal ground
8	GND	Power	Signal ground
9	RESET_N	Digital IO	Holds KO310 in reset while low
10	IRQ_N	Digital IO	Interrupt signal output (active low)
11	ANT0	Digital IO	GPIO that can be used to select antenna positions
12	ANT1	Digital IO	GPIO that can be used to select antenna positions
13	ANT2	Digital IO	GPIO that can be used to select antenna positions
14	ANT3	Digital IO	GPIO that can be used to select antenna positions
15	SPI_SS	Digital IO	SPI slave select (active low)
16	SPI_SCLK	Digital IO	SPI clock
17	SPI_MOSI	Digital IO	SPI master output slave input
18	SPI_MISO	Digital IO	SPI master input slave output
19	READY_N	Digital IO	SPI slave ready signal output (active low), boot to application/bootloader pin
20	ENABLE	Digital IO	Chip enable input
21 - 52	GND	GND	Ground

Interfacing to the KO310

- Power and Ground

All circuits on the KO310 are powered from a single input at pin 6. The KO310 operates with any supply voltage between 4.75 and 5.25V. Because the individual supplies within the part are regulated on the KO310, a large amount of supply filtering is not required. A high value, low ESR tantalum capacitor (150uF or greater) is recommended and should be accompanied by a 0.1uF ceramic chip capacitor close to the pin.

All 36 available ground pins of the KO310 must be soldered to the user PCB per the recommended assembly guidelines. If the PCB utilizes separate analog/RF and digital grounds, it is recommended that the KO310 connect to the analog/RF ground. Providing a highly conductive path from the module ground to a continuous ground plane (by use of numerous vias to the ground plane) and as much ground conductor area as possible on the outer layers of the user PCB will help to reduce the KO310 temperature rise during operation.

- Communication

The KO310 module communicates via SPI (Serial Peripheral Interface). The module acts as an SPI slave. The module has additional digital IOs that help coordinate SPI communication with the host, including the READY_N and IRQ_N pins.

The SPI uses 8-bit words, communicated most significant bit first. If multiple bytes are sent, they are sent with the most significant byte first. Both are “big endian”. The SPI CPOL = 0, which means the clock signal SCLK idles low. The SPI CPHA = 1, which means the data pins MOSI and MISO states should change on the rising edge of the clock, and be sampled on the falling edge of the clock.

- RF

The KO310 is configured for monostatic operation, which requires only a single RF I/O pin for full duplex communication. The output must be routed to the antenna via 50 ohm microstrip or stripline on the product PCB. No coupling capacitor is required given that the RF pin is AC-coupled internal to the KO310. To maximize the radiated power (and corresponding communication range), the length of the transmission line between KO310 and antenna should be made as short as possible. Please refer to the Regulatory Guidelines section for acceptable connectors and antenna types to ensure FCC and IC compliance in the USA and Canada. The maximum output power of the KO310 is 27 dBm (500 mW). Refer to the “AT721003391 - FCC Antenna DataSheet” and “AT721003391 - EU Antenna DataSheet” for more information relating to the antennas approved for use with the KO310 module.

GPIO

There are six user-configurable digital GPIOs on the KO310. The signals are number RF[1:0] and ANT[4:1]. In most applications, RF[1:0] control and RF switch that will connect the

KO310 module to one of up to four antennas. ANT[4:1] are used as address lines for Coca-Cola Freestyle antennas that support the proprietary positional awareness feature. Each GPIO operates at standard 3.3V CMOS logic levels with a minimum output current capability of 8 mA per pin while maintaining guaranteed noise margins. The pins can source/sink up to 20 mA with reduced/increased V_H or increased V_L . All I/O is rated to withstand a discharge of 2 kV using the Human Body Model (HBM). Appropriate interface circuitry and layout as well as handling of the target hardware should be applied.

Package Dimensions

